

Title: Wacky Weather

Brief Overview:

Students will explore U.S. hurricanes and droughts in order to analyze and represent data in various ways. Collect, organize and analyze data to construct bar graphs, circle graphs, and to find fractions of a set. Compare extreme weather episodes, using data and fractions of sets. The students will investigate mathematical trends and present their findings to other students.

NCTM 2000 Principles for School Mathematics:

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*
- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*
- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*
- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*
- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*
- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

Links to NCTM 2000 Standards:

- **Content Standards**

- **Number and Operations**

- *Understand numbers, ways of representing numbers, relationships among numbers, and number systems; recognize equivalent representations for the same number and generate them by decomposing and composing numbers; develop understanding of fractions as parts of unit wholes, as parts of a collection, as locations on number lines, and as divisions of whole numbers; use models, benchmarks, and equivalent forms to judge the size of fractions; and recognize and generate equivalent forms of commonly used fractions, decimals, and percents.*
 - *Understand meaning of operations and how they relate to one another; understand various meanings of multiplication and division; and understand the effects of multiplying and dividing whole numbers.*

- *Compute fluently and make reasonable estimates; develop and use strategies to estimate computations involving fractions and decimals in situations relevant to students' experience; and select appropriate methods and tools for computing with whole numbers from among mental computation, estimate, calculators, and paper and pencil according to the context and nature of the computation and use the selected method or tools.*

Algebra

- *Understand patterns and relations; and represent and analyze patterns using words, tables, and graphs.*
- *Use mathematical models to represent and understand quantitative relationships; and model problem situations with objects and use presentations such as graphs, tables, and equations to draw conclusions.*
- *Analyze change in various contexts; investigate how a change in one variable relates to a change in a second variable; and identify and describe situations with constant or varying rate of change and compare them.*

Geometry

- *Specify locations and describe spatial relationships using coordinate geometry and other representational systems; describe location and movement using common language and geometric vocabulary; make and use coordinate systems to specify locations and to describe paths; and find the distance between points along horizontal and vertical lines of a coordinate system.*
- *Use visualizations, spatial reasoning, and geometric modeling to solve problems; build and draw geometric objects; create and describe mental images of objects, patterns, and paths; identify and build a three-dimensional object from two-dimensional presentations of that object; identify and draw a two-dimensional representation of a three-dimensional object; use geometric models to solve problems in other areas of mathematics, such as number and measurement; and recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life.*

Data Analysis and Probability

- *Formulate questions that can be addressed with data and collect, organize and display relevant data to answer them; collect data using observations, surveys, and experiments; and represents data using tables and graphs such as: line plots, bar graphs, and line graphs.*
- *Select and use appropriate statistical methods to analyze data; describe the shape and important features of a set of data and compare related data sets, with an emphasis on how data are distributed; use measure of center, focusing on the median and understand what each does and does not indicate about the data set; and compare different representations of the same data and evaluate how well each representation shows important aspects of the data.*
- *Develop and evaluate inferences and predictions that are based on data; and propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.*

- **Process Standards**

- Problem Solving**

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to build new mathematical knowledge through problem solving; solve problems that arise in mathematics and in other contexts; apply and adapt a variety of appropriate strategies to solve problems; and monitor and reflect on the process of mathematical problem solving.*

- Reasoning and Proof**

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize reasoning and proof as fundamental aspects of mathematics; make and investigate mathematical conjectures; develop and evaluate mathematical arguments and proofs; and select and use various types of reasoning and methods of proof.*

- Communication**

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to organize and consolidate their mathematical thinking through communication; communicate their mathematical thinking coherently and clearly to peers, teachers, and others; analyze and evaluate the mathematical thinking and strategies of others; and the language of mathematics to express mathematical ideas precisely.*

- Connections**

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to recognize and use connections among mathematical ideas; understand how mathematical ideas interconnect and build on one another to produce a coherent whole; and recognize and apply mathematics in context outside of mathematics.*

- Representation**

- *Instructional programs from pre-kindergarten through grade 12 should enable all students to create and use representations to organize, record, and communicate mathematical ideas; select, apply, and translate among mathematical representations to solve problems; and use representations to model and interpret physical, social, and mathematical phenomena.*

Links to National Science Education Standards:

- **Unifying Concepts and Processes**
- **Science as Inquiry**
- **Earth and Space Science**
- **Science and Technology**
- **Science in Personal and Social Perspectives**
- **History and Nature of Science**

Grade/Level:

Grades 4-5.

Duration/Length:

Five class periods/50 minutes per day

Prerequisite Knowledge

Students should have working knowledge of the following skills:

- Estimating, rounding, and place value
- Constructing fractions
- Recognizing fractions as parts of a whole
- Simplifying fractions
- Creating equivalent fractions
- Use of calculators
- Constructing bar and circle graphs from basic data
- Analyzing basic graph data
- Gallery Walk
- Circle in a Circle game

Student Outcomes:

- Collect, organize, and analyze data to create a bar graph and circle graph.
- Record locations on a map
- Find fractions of a set
- Make comparisons using data and fractions of a set
- Use manipulatives to find fractional parts
- Construct Venn Diagram
- Integrate science knowledge with mathematical statistics

Materials/Resources/Printed Materials:

- Pencils
- Manipulatives-transparent tiles and snap cubes
- Calculators
- Student Resource Sheets #1-11
- Overhead projector or chalkboard
- Teacher Resource Sheet #1

Development/Procedures:**Day 1:**

- Begin the unit with a discussion of unusual weather conditions. Make a list of the extreme conditions such as hurricanes, tornadoes, blizzards, and droughts. Use the overhead while generating the list.
- Ask the students how these conditions affect them.
- Break into cooperative groups of 3 to 5 students and brainstorm about how math relates to weather conditions. Elicit from students examples such as, measuring rainfall, erosion effects, and estimation of costs of damage.
- Have students come together to share their ideas.

- Read together Student Resource Sheet #1, "Furious Floyd", about one of the severe weather conditions discussed earlier. Then break into groups again to look for possible math problems found in "Furious Floyd". Model one example with students. One possibility is "How many days did Hurricane Floyd last?" Use Student Resource Sheet #2, to record the math problem generated by each student. Share problems within the groups.
- Play the "Circle within a Circle" game using the problems generated by the students. Directions to the game are explained on Student Resource Sheet #2.
- Close with a journal entry about how math and weather are related.

Day 2:

- Begin the lesson with reading some of the journal entries to review the prior lesson.
- Refer students back to Student Resource #1. Ask students if there is another way to represent the information given in the article. Elicit that another type of graph might organize the information in a way that may be easier to understand.
- Direct students to Student Resource #3. Use the bar graph to represent the total amount of rainfall for each of the states. Discuss the results. Reveal which states had the most or least amount of rainfall. Ask the students what other information can be gathered from the graph. List the information presented by the students, such as two sets of states each have the same amount of rainfall.
- Ask students to take a Gallery Walk to view the bar graphs.

Day 3:

- Ask students to refer to the bar graph completed the day before. Review the information gathered from the graph.
- Introduce vocabulary-fraction of a set.
- Model another way (fraction of a set) of representing the information with the use of a bar graph and snap cubes on the overhead projector.
- Refer students to Student Resource Sheet #4 (SRS). The directions for using snap cubes are explained on SRS #4 and model the example for them.
- Direct the students in pairs to complete Student Resource Sheet #4. Students will make a table, use manipulatives and write a number sentence.
- Ask students to divide into arranged groups and list the attributes of a fraction of a set using the Placemat (Teacher Resource Sheet #1). In the center of the placemat, develop a definition for fraction of a set including the attributes generated by the group
- Share the definitions with the class.

Day 4:

- Review fraction of a set using Student Resource Sheet #5.
- Share answers for Student Resource Sheet #5
- Brainstorm about the damage caused by the hurricanes.
- Introduce and discuss the damage in dollars caused by the most costly hurricanes in the last forty years.
- Introduce and model the activities for several of the hurricanes listed on Student Resource Sheet #6.
- Using a calculator and working with a partner, complete the activities on Student Resource

#6 and #7.

- Share circle graphs with the class.

Day 5:

- Use a current newspaper article or read Student Resource Sheet #8 to introduce droughts. Discuss the effects of the current drought on our state and country.
- Direct a student or students to the computer to check on updates and report findings.
- Introduce the weather map on Student Resource Sheet #9.
- Use transparent tile manipulatives and Student Resource Sheet #9 to find the fractional part of the United States recovering from drought, labeled as a drought area, labeled as but not a “declared” drought area, labeled as a drought watch area, and unaffected by the drought. To use the transparent tiles, demonstrate on the overhead how you can overlay a map and estimate the approximate fractional area covered by the tile. Answers may vary for each student. Measure each region separately. You may wish to use various measuring manipulatives such as diamond shaped tiles or a centimeter grid transparency.
- Chart the results on a graph of choice (line, bar, circle, etc.).
- Using the Venn Diagram (Student Resource Sheet #10), compare and contrast hurricanes and droughts including the results of Student Resource activities.

Performance Assessment:

Assessment will be ongoing. Students will be assessed informally and formally on the following activities.

- Student Resource Sheets # 2,3,4,5,6,7,9,10
- Individual and group participation
- Teacher observation
- Rubric for Wacky Weather summary

Extension/Follow Up:

- Plot the movement of hurricane Floyd on a map using longitude and latitude.
- Research and report on one of the hurricanes on the list of the most costly hurricanes. Compare to hurricane Floyd.
- Research the effect of the drought in your area (water bans, etc.)
- Visit earthobservatory.nasa.gov/Study/FloydIntro/ **or**
www.timeforkids.com/TFK/magazines/story/0,6277,54960,00.html **or**
[www..discovery.com/news/features//drought/drought.html](http://www.discovery.com/news/features//drought/drought.html) **or**
enso.unl.edu/ndmc/impact.htm

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Furious Floyd

From the 14th through the 18th of September 1999, hurricane Floyd brought flooding rains, high winds, and rough seas along much of the Atlantic coast. The hurricane began over the Atlantic Ocean and grew in intensity until it reached 155mph winds. Floyd weakened to a tropical storm after crossing Virginia. It moved up the coasts of Delmarva Peninsula, New Jersey, New York and New England before moving out to sea.

Rainfall was heavy and produced much inland flooding. Approximately, 20 inches of rain fell on North Carolina. Virginia received about 15 inches. As the storm moved north, it weakened and there was less rainfall. Maryland received about 14 inches, Delaware 14 inches, and New Jersey 11 inches. Both Pennsylvania and southeastern New York had a total of 8 inches each. Over portions of New England 10 inches of rain fell. Total damage estimates range from three to six billion dollars.

Name _____

BRAINSTORMING AND SHARING THE MATH OF THE STORM

After reading the Hurricane Floyd Resource Sheet #1, brainstorm with your group to write as many math problems related to the hurricane as you can think of. Record both the problems and solutions to the problems.

Circle Within A Circle Game

Choose one of your problems and write it below. On the other side of this paper write the answer to the problem. The teacher will give you a letter “A” or “B”, and then you will join a circle group. If you are an “A” join the outside circle and face into the circle. If you are a “B” join the inside circle and face the outside circle people. “A” person and then “B” person will share your question with the person opposite you. Help the person with the answer if they are having difficulty. When finished questioning and answering, exchange sheets with the person opposite you and move according to the teacher’s directions.

Question:



RAGING RAIN BAR GRAPHING

NAME _____

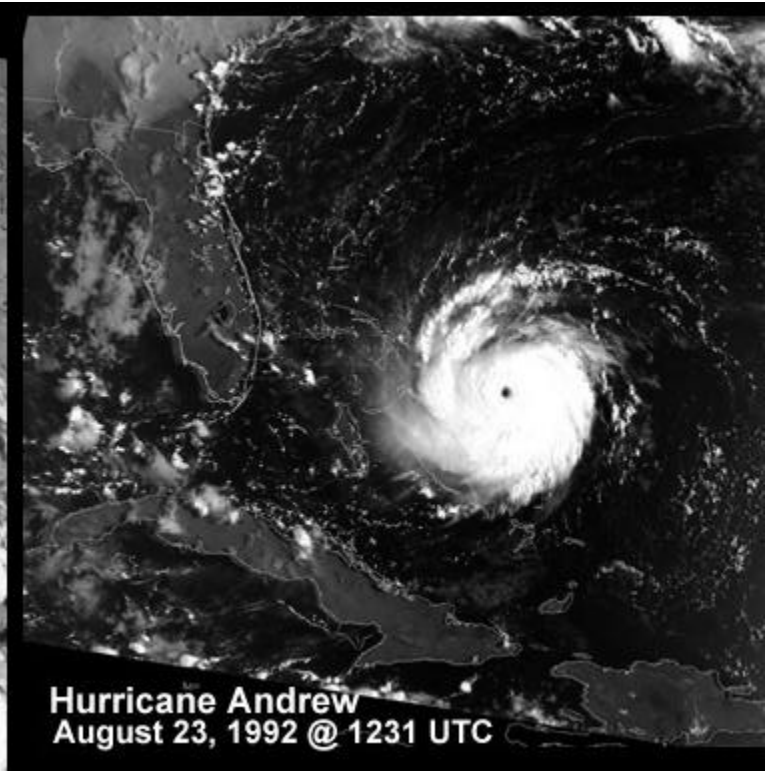
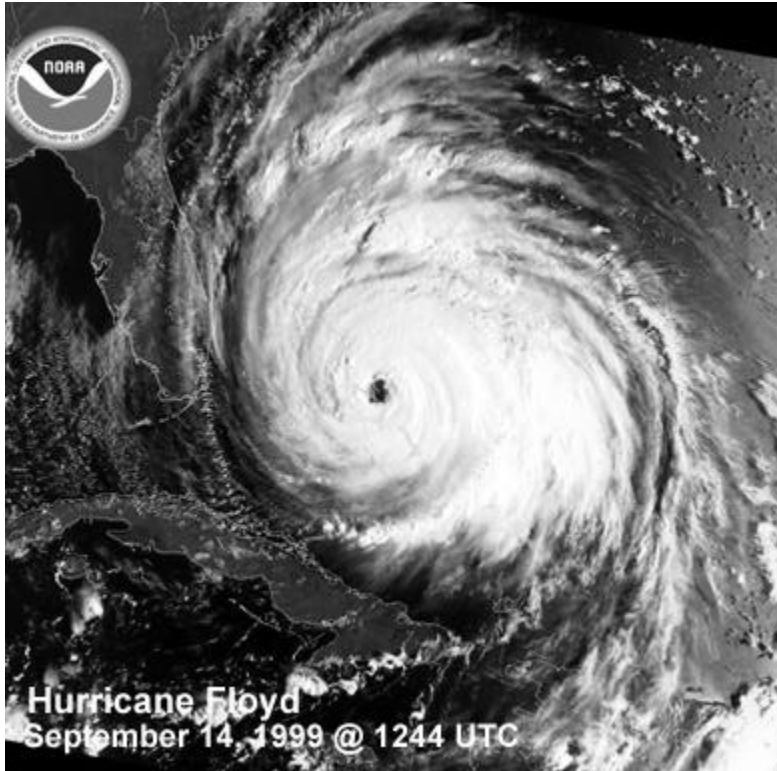
Directions for graphing rain data:

Using the information from Resource Sheet #1, graph the rainfall of at least 7 states in the United States affected by Hurricane Floyd. You may abbreviate the state names. Be sure to label the axis, title your graph, and accurately record the rainfall.

FUN WITH FIGURING FRACTIONS

Name _____

FEROCIOUS FLOYD AND AUDACIOUS ANDREW ACTUALLY FRACTIONALLY



You are going to compare the size of Hurricane Andrew to Hurricane Floyd. Use your transparency grid to estimate the number of square centimeters that computes the approximate area of each hurricane. Write a proper fraction that shows the comparison of Andrew's size to Floyd's size.

BURDENSOME BILLIONS

Hurricanes causing more than \$1 Billion in Damages in the United States 1990 - 1999

1. **ANDREW 1992 - (South Florida/SE Louisiana). \$26,500,000,000 (\$ billion)**
2. **HUGO 1989 - (South Carolina). \$7,000,000,000 (\$ billion)**
3. **FLOYD 1999 – (East Coast of US). \$5,500,000,000 (\$ billion)**
4. **FRAN 1996 - (North Carolina/Virginia). \$3,200,000,000 (\$ billion)**
5. **OPAL 1995 - (Florida Panhandle). \$3,000,000,000 (\$ billion)**
6. **FREDERIC 1979 - (Alabama/Mississippi). \$2,300,000,000 (\$ billion)**

Student Activity:

Students will complete the list by rounding the damage costs to the nearest billion. For example, Betsy in 2000 cost \$8,420,700,000. This would be 8 billion. Complete the table below.

Add the total cost for all of the hurricanes on the list. Using the circle graph on Student Resource Sheet #7, construct a circle graph that shows the fractional part of the total damage cost each hurricane represents. Divide your circle into 12 equal segments. Use the clock numbers to help guide you. Place the marks on the circumference of the circle. Then find the center point and make lines with a ruler to designate the correct fractions of a circle for each hurricane. Make sure you include a title and labels (hurricanes, amount of cost, and fraction of the total cost. You will use your calculators to compute the fraction of a whole of each hurricane.

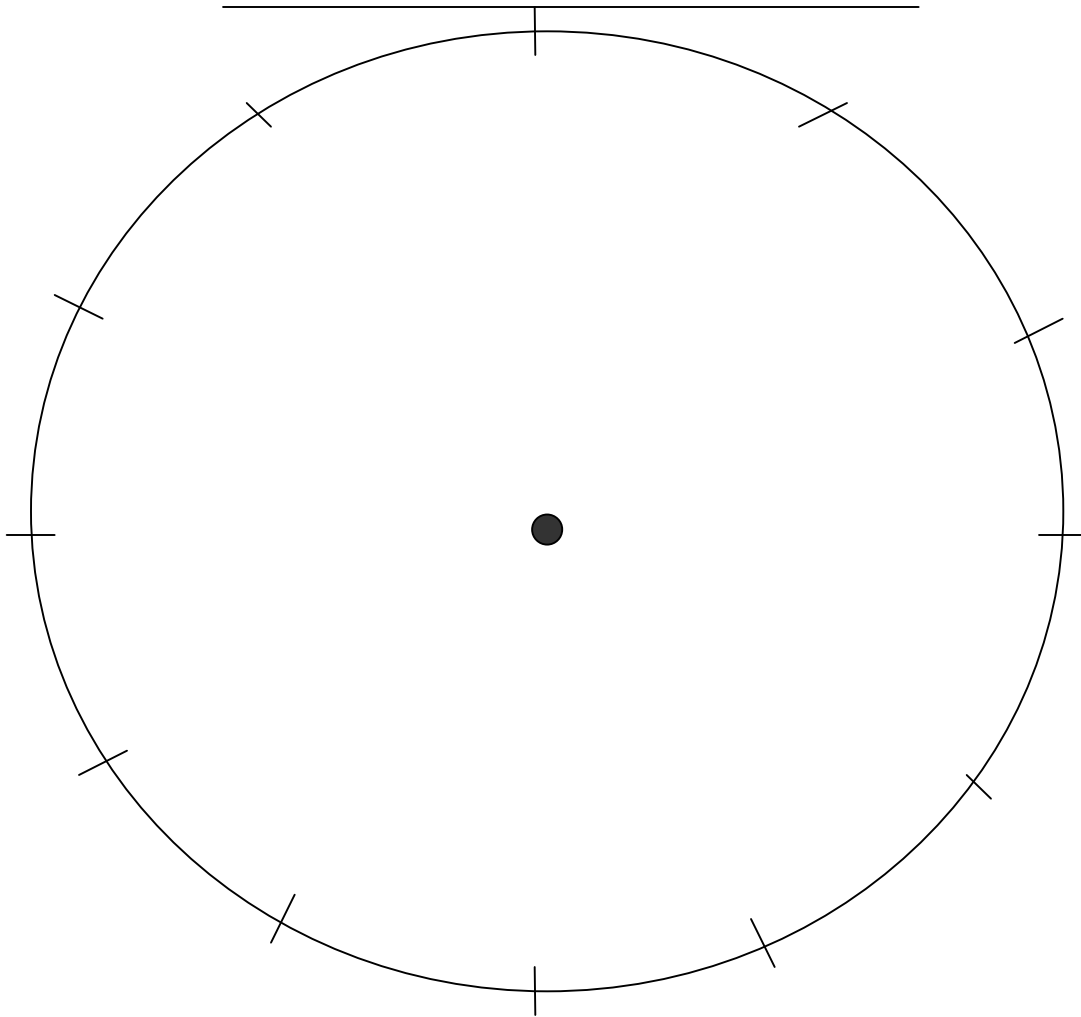
Calculator directions: Enter cost for a hurricane (rounded form). Divide by total costs for all the hurricanes (use a slash), press “simp” to simplify fraction if possible. Record the math table below.

Hurricane Table

Hurricane	Cost of Hurricane	Total cost - of Hurricanes	Fraction	Number Sentence
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For example:

[illegible]

CIRCULATING CYCLONES IN A CIRCLE GRAPH**Student Activity:**

Graph the information concerning costs of the destruction caused by the most costly hurricanes in the 1990's. You will find the center point of the circle. Use a ruler to mark the segments. It would probably be best to divide the circle into twelve equal parts with dots on the circumference as guides. Use a model clock to help you find the twelfths. Remember to title and label your graph with states, costs, and fractions of the set.



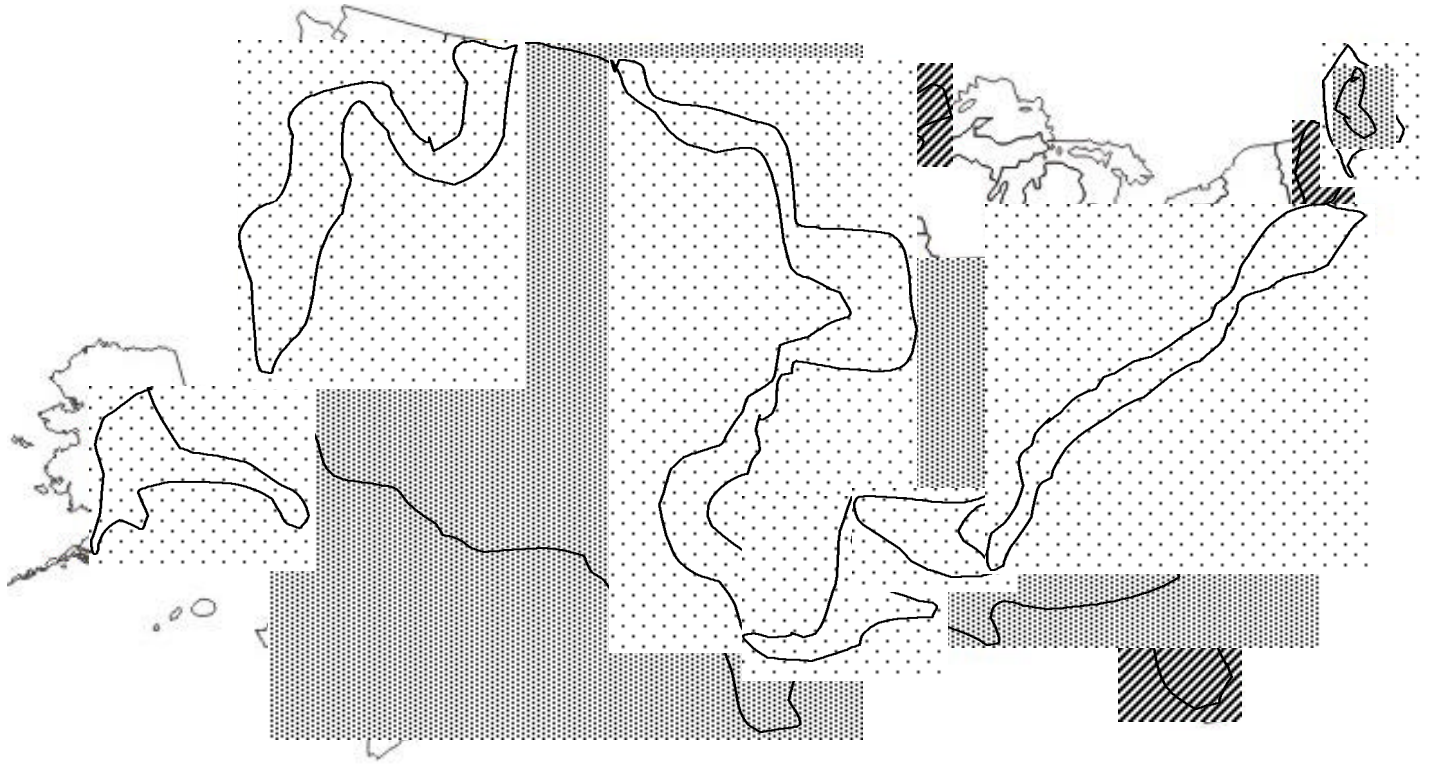
DEVASTATING DROUGHT 2002

Droughts have caused many concerns and impacts this year in the United States. Of particular concern is the impact on farmers and their agricultural products. Corn and soybean production is down which causes farmers to request loans to keep from going bankrupt. Temperatures in the farm areas were generally 4 to 10 degrees F above normal. Topsoil moisture has ratings of about 75% of normal. This lack of moisture stunts the growth of plants.

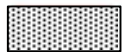
In the Plains and Midwest areas, this year Nebraska's rainfall is 81% below normal. Colorado is 69% below normal and Kansas is 64% below the average. These are crop-producing states that are in particular stress.

In western US, wildfire activity left Oregon with 17 of the nation's 41 large fires. This resulted in the loss of 210,000 acres of vegetation. This year wildfire acreage totaled about 3.75 million acres, which is 2 times the 10-year average. The government granted \$145 million for wildfire management.

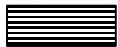
2002 DEVASTATING DROUGHT AREAS IN THE UNITED STATES



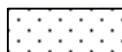
Recovering from drought, but should be monitored closely for recurring conditions or lingering impacts



Labeled as a drought area by the US Drought Monitor. Portions of states within this region have been “declared” as drought areas by the state or federal government



Labeled as a drought area by the US Drought Monitor. States within this region have not been “declared” as drought areas by the state or federal government



Drought watch areas

Student Activity:

Read the descriptions of each drought area in the key. Use transparent snap cube squares to overlay each area and estimate the amount of area that is affected by the drought. Find the fractional part of each area: recovering area, declared drought area, not declared area, watch area, and unaffected area. Decide upon a graph of your choice to record the data and compare the various area conditions.

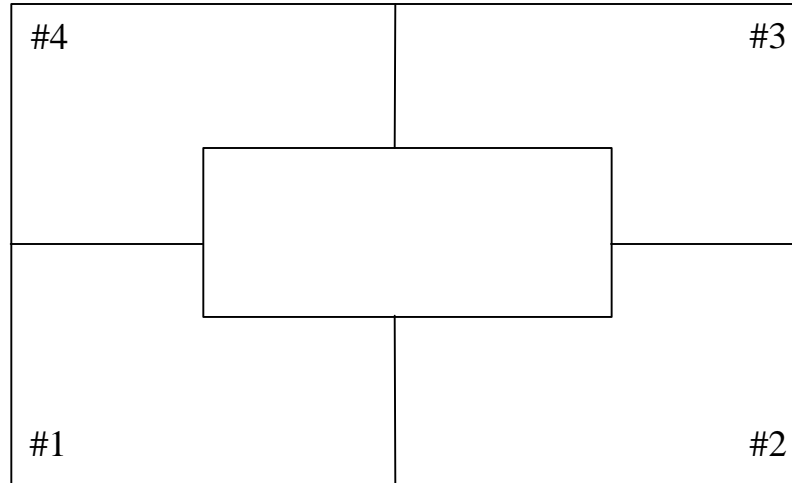
Name _____

HURRICANE VENN AND PEN CONCLUDING ACTIVITY

HurricanesDroughts

Compare hurricanes with drought conditions. Include data, particularly fraction data to compare each weather condition. You may use any of the previous resource sheets, graphs, or math that you have computed. When you have completed the Venn, write a summary of your information to report what you have learned about Wacky Weather, its impact on our nation's economy, and concerns for our lives.

Placemat Strategy



1. Give a piece of large chart paper to each group of four students.
2. Instruct the students to draw a design like the one above.
3. Each student will choose a number (1 – 4) and then assume a role according to the chart.

#1 Recorder

#2 Facilitator

#3 Timekeeper

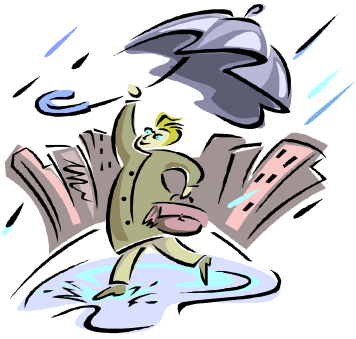
#4 Spokesperson

4. Pose a question to the students. (Example: What do you know about Brazil?) Let the students brainstorm all ideas by writing in the space in front of them.
5. Then, the facilitator will focus the discussion and the recorder will record all ideas in the center that are agreed upon by consensus. The timekeeper will remind the group of the time.
6. Finally, hang up the placemat. The spokesperson tells the rest of the class what their group has agreed upon.



Burdensome Billions

Hurricane	Cost of Hurricane (In billions)	Total cost - of Hurricanes (In billions)	Fraction	Number Sentence
Andrew	\$27	\$48	$27/48 = 9/16$	$9/16$ of 48 = 27
Hugo	7	48	$7/48$	$7/48$ of 48 = 7
Floyd	6	48	$6/48 = 1/8$	$1/8$ of 48 = 6
Fran	3	48	$3/48 = 1/16$	$1/16$ of 48 = 3
Opal	3	48	$3/48 = 1/16$	$1/16$ of 48 = 3
Frederic	2	48	$2/48 = 1/24$	$1/24$ of 48 = 2



RAGING RAIN BAR GRAPHING

Burdensome Billions

